TETRA TECH EC, INC.

10-July-2008

Transportation Corridor Agencies
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Subject: **Review and Assessment of Documents Related to the *Final Runoff Management Plan, State Route 241 Proposed Extension*, 26-July-2007**

Contract: **TCA Letter of Agreement No. K000409; Tetra Tech EC Contract No. 106-3679**

INTRODUCTION

I am providing the Transportation Corridor Agencies (TCA) with this letter summarizing my review and assessment of several reports, letters and memos concerning the proposed extension of State Route 241 in Orange County, California and issues related to hydromodification. I appreciate this opportunity to provide you with my thoughts on the content and presentation of these documents and your encouragement for me to comment freely on all materials.

My experience with hydromodification issues comes primarily from three areas. First, I did my graduate work in fluvial geomorphology looking at channel maintenance, flood plain formation, and bankfull discharge frequency on perennial streams in Maryland. Second, I spent my early professional career on several projects concerned with watershed and channel processes related to erosion, sedimentation, and flooding, also in Maryland. The State of Maryland has always been a leader in storm water management as well as a geographic region where many of the studies that have contributed to our current understanding of channel responses to development (i.e., hydromodification) were performed. Working in that location on projects of this type raised my awareness of, and interest in, impacts to stream channels from changes within their watersheds. My third area of experience is derived from 20 years of work on projects in southern California, including a recent investigation of the impacts from development on stream channels in southern California, most of which are ephemeral (Coleman, et al. 2005). Our project was the first of its kind in southern California and included several study sites within Orange County.

Because Coleman, et al. (2005) is directly related to the issues of concern to the proposed toll road extension, and because it has been cited in one of the letters I have reviewed here, you asked me to provide my professional assessment of the interpretation of our results and the general consideration of hydromodification in all of these materials. The specific materials I have reviewed are summarized in Attachment A, and include letters, memos, reports, and attached articles. Primary authors for these materials included Philip Williams and Associates (PWA), hired by the Surfrider Foundation, and RBF Consulting, hired by the TCA. Both of these firms are well-respected in surface water resource evaluations in general, and in hydromodification study and assessment in particular. In fact both were associated with the groundbreaking work recommending mitigation measures to address hydromodification concerns within the Santa Clara Valley of the San Francisco Bay Area (Santa Clara Valley Urban runoff Pollution Prevention Program, or SCVURPPP <http://scvurppp-w2k.com/Default.htm>). PWA helped prepare this report and Scott Taylor, of RBF, reviewed it as a part of his work for the California Stormwater Quality Association (CASQA).

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SUMMARY

I provide more detailed comments below, but offer a summary of my conclusions about these materials here to introduce and frame my remarks. It is my opinion that the design team hired by the TCA, and represented by RBF in the reviewed materials, has made every effort to comply with the letter and spirit of Orange County's storm water permit (NPDES No. CAS0108740) intended to address hydromodification changes that can result from development within a watershed. They propose to use currently accepted approaches and techniques that are recognized as the best means to mitigate possible impacts from hydromodification. They also follow standard engineering practice in project planning and design by developing design objectives initially to make sure that all interested parties can agree to the intent of various design features before actual plans and specific design drawings are prepared. They are working in a structured and professional way to proactively create a design that will address all of the identified issues (including hydromodification) to the best possible effect.

PWA, on the other hand, has adopted the role of project opponent, which puts them in the position of finding fault with proposed design measures or attempting to create uncertainty about the effectiveness of the project approach to hydromodification issues and their root causes. Unfortunately, it seems to me they are using their knowledge of hydromodification to confuse issues and create uncertainty about what "might" happen rather than what is likely to occur.

ISSUES

The discussion of issues in the materials reviewed included assertions and counter assertions about a relatively small number of common topics. I would characterize these discussions as falling into the following four primary "issues" (as they relate to hydromodification). There were other discussions on which I am not commenting, either because I don't feel they are significant issues or they are outside of the field I feel qualified to discuss. The list below also provides my interpretation of the basis of each issue.

1. **Watershed Scale**. Much discussion was devoted to the appropriate scale at which to evaluate hydromodification issues and address them through mitigation measures. In the current debate this translates into whether or not it is advisable to divide the larger San Mateo Creek watershed into sub-watersheds.
2. **Disturbed vs. Impervious Areas**. Investigation of hydromodification performed by Coleman, et al. (2005) focused specifically on the changes in impervious areas (rooftops, pavement, or concrete areas) and the resulting changes to the stream channel. "Disturbed" areas from land clearance, grading, or cut and fill were not considered the same as "impervious" areas in evaluating the impacts from hydromodification.
3. **Effectiveness of Proposed Mitigation Measures**. The premise of many investigations of hydromodification, is to evaluate the changes to stream channels in the absence of any mitigation measures. The field sites selected for the investigation described in Coleman, et al. (2005) attempted to select such sites so that the results describe impacts to unmitigated systems.
4. **Erosion and Sedimentation**. Erosion and sedimentation include consideration of source area (upland or non-channel vs. in-channel), transport (overland vs. within-channel), and deposition location(s). Particle size is also an important factor in the discussion for this watershed system and the near-shore beach environment.

ASSESSMENT

My assessment of the issues includes an interpretation of how each side in the discussion represented their position, and the technical merit of that position.

1. Watershed Scale.

PWA suggests (PWA-1, PWA-4) that evaluating hydromodification issues, and addressing them through mitigation measures, should not be conducted on the scale of the entire San Mateo Creek watershed. They offered an alternative evaluation method that would look at individual sub-watersheds tributary to either San Mateo Creek or Cristianitos Creek. RBF contends (RBF-1) that they have considered hydro-modification in their evaluation and design because they positioned their proposed mitigation features along individual "tributaries" of the larger watershed.

My feeling is the use of an entire watershed or a portion of that watershed (sub-watershed) is not the crucial point in this discussion, because any size of evaluation area is acceptable as long as the "watershed" considered is only that area draining to the specific point in the channel in which you are interested. The assessment methods used in southern California (Coleman, et al. 2005) considered a relatively short channel "reach" in relation to the location from which the watershed was defined. This was a reach with a length of 5 to 10 times the width of the channel at the "bankfull" stage. This is a variable length, but one that was generally a few hundred feet long. Therefore, any discussion of impacts to a channel from changes within a "watershed" area should be confined to that relatively short reach at the specific outlet from which that watershed is defined. Also, as soon as a confluence is reached and two channels come together, it is no longer appropriate to consider only the smaller sub-watershed in the evaluation of the downstream reach, but should incorporate the larger watershed area of both channels. Hence, the PWA recommendation for sub-watershed evaluation is reasonable, but only for the reach at the sub-watershed outlet and not for points downstream, such as the lagoon area or the beach. I expand this discussion a little further in my assessment of *Erosion and Sedimentation* below.

The fact that their initial presentation of disturbed area calculation was so ambiguous, and their subsequent clarifications still did not use any maps showing delineated watersheds, also suggests to me that the intent of this PWA discussion was to cause uncertainty rather than clarity. I am not sure yet that I understand how they calculated the percentages of "impermeable" area for specific sub-watersheds. The idea of what PWA used as, or considered to be, impermeable is discussed next in *Disturbed vs. Impervious Areas*.

2. Disturbed vs. Impervious Areas.

Although not directly stated, PWA implies (PWA-1, PWA-3, PWA-4) that disturbed areas, specifically the cut and fill areas for the proposed roadway, would act the same as impervious areas in evaluating the impacts from hydromodification. RBF did not respond directly to this implication because it was not stated directly.

I believe this implication is a distortion of the assessment of impacts from hydromodification. Depending on the kind of change that occurs, a disturbed area can act in a similar manner to an impervious area. But this is generally only a short-term condition, not a long-term condition or a permanent change. Thus it does not appear that PWA has treated this discussion as thoroughly as I believe it should be treated. I suggest they should indicate that if disturbed areas behave as impervious areas, this will likely be the case only for the period of time before revegetation takes hold, and this would limit the duration of time during which impacts from the disturbance would occur. In consideration of the long-term case, the percentage of impervious area should be smaller than the percentage presented by PWA, which includes both impervious and disturbed areas. Since they failed to note that there are likely to be differences between

short-term and long-term conditions, they are implying that disturbed areas are the same as impervious areas in terms of runoff.

I would further suggest that PWA fails to acknowledge that the proposed erosion and sedimentation measures in the disturbed area will have any impact at all on the rainfall runoff process. I suspect these mitigation measures will delay runoff somewhat, causing the disturbed areas to act less like an impervious area than they would if there were no mitigation measures.

3. Effectiveness of Proposed Mitigation Measures.

In their initial critique of the mitigation measures proposed for the toll road extension PWA suggests (PWA-1, PWA-3) that these measures probably will not be very effective and were not designed for mitigation of hydromodification impacts. In addition, PWA faults the design for a lack of flow control (PWA-1), then changes that criticism to a lack of focus on controlling flow rates and durations (PWA-2). In their conclusions and in-depth evaluations, PWA phrases their critique to imply that the mitigation measures will have no effect (PWA-5). RBF responds by restating the purpose of individual measures and their intent to address potential hydromodification impacts with the suite of mitigation measures incorporated into the design objectives for the project (RBF-2). They further assert that the design objective for the detention basins will be to control outflows from the new roadway (i.e., the new impervious areas) so that flow duration curves under proposed conditions will match the flow duration curves under current conditions. I believe this issue is potentially the most significant of the group that I am discussing, and presents the greatest difference of opinion between the project proponent and the project opponent.

The reason for investigating hydromodification impacts is to better understand watershed and stream channel processes in the local area, and their response to watershed development. To do this in southern California, our investigation selected sites that did not have the benefit of any mitigation measures to help control runoff within developed or developing watersheds (Coleman et al. 2005). In this way, we could evaluate the unimpeded processes and make recommendations about how to best control the effects of hydromodification. The proposed toll road extension has benefited from this type of research by providing the design team with many possible mitigation measures. Even though PWA has participated in such investigations elsewhere that helped develop just such recommendations for mitigating hydromodification impacts, they appear to reject these same mitigation measures on this project in their role as advocate for the project opponent. By arguing that mitigation measures will have no effect, PWA enhances the idea that changes in imperviousness due to toll road development will be significant. If they admit that mitigation measures could have a significant role in reducing the effects of hydromodification, they weaken their argument that changes in impervious area will be important. Therefore, it is necessary for them to create uncertainty about the performance of proposed mitigation measures, which they do without actually providing an objective assessment of that performance.

4. Erosion and Sedimentation.

Discussion of erosion and sedimentation relative to hydromodification is primarily focused on accelerated in-channel erosion resulting from increased surface water runoff that is due to development within a watershed. The increases in runoff within developed watersheds are a combination of higher percentages of rainfall becoming runoff (because of a larger impervious surface area) and greater efficiency transporting runoff to stream channels (because of new storm drain systems). Therefore, channels see greater peak discharges and larger runoff volumes for the same amount of rainfall after development than would have been the case before development. This causes increased erosive forces within the channel which result in channel erosion and enlargement. PWA broadens the discussion of erosion and sedimentation in the reviewed materials to include upland (above or out-of-channel) erosion

in addition to within-channel erosion and sediment transport (PWA-1, PWA-3, PWA-4, PWA-5, and PWA-6). The potential upland erosion sources identified by PWA are the disturbed areas associated with roadway cut and fill. The channel sources of erosion are downstream from the roadways, and therefore downstream of potential upland sources. RBF notes (RBF-3) that the design objectives of the project include both source-control best management practices (BMPs) to prevent upland erosion, and downstream flow controls to keep in-channel flow rates during and after construction very close to existing conditions.

Whether or not the control measures proposed by the project for upland erosion or flow control will be effective is open for debate, and PWA makes their case that they will not be effective (again without any real justification or supporting evidence). I believe PWA over-simplifies their discussion of erosion and sedimentation by focusing independently on potential sources of eroded sediment, concluding worst-case scenarios for each, ignoring the complexity of the sediment delivery system, and allowing no benefit from proposed control measures. Conversely, RBF makes the case that the design team has used all the reasonable and appropriate measures to control both (a) upland erosion (and off-site transport) of sediment, and (b) the potential changes in hydrology (increases to flows) that cause hydromofication and in-channel erosion. The design team has applied current knowledge of the hydromodification process in order to control such changes and create the best opportunity to limit their impact. While there are no guarantees such impacts will be reduced to zero, I have greater confidence that these measures will provide a significant level of control than I do in the predictions that these measures will have no impact.

On another subject, PWA suggests that if sediment loads increase due to the construction of the toll road, whether from upland sources or channel sources, the "fine" sediment load would increase (PWA-3, PWA-5, and PWA-6). Although I do not necessarily agree with their expected magnitude of increase, I do acknowledge the likelihood that fine sediment load will increase, most likely during the construction phase of the project when erosion is most difficult to control. However, I do not subscribe to the idea that an increase in fine sediment load (which is transported in suspension) would reduce the effectiveness of channel flows to carry the very coarse cobbles (transported as bedload) that are important to the Trestles surfing area. I believe this is particularly true for the relatively small increase in suspended sediment I would expect from the project given all of the proposed control measures.

CONCLUSIONS

Given that PWA has been involved with many efforts to evaluate and assess hydromodification issues, they are in a good position to know the causes of hydromodification and the challenge of selecting mitigation measures. However, in this situation they have used their knowledge in a negative way to create uncertainty about the proposed design objectives so that a project opponent might argue against the project in its entirety, rather than to work proactively toward achieving better design objectives or outcomes. PWA was part of the team that worked on preparing a hydromodification management plan (SCVURPPP 2005) which provided recommendations for many of the measures the TCA has adopted in the Runoff Management Plan (RMP; SBC-1), and yet they have provided materials for the Surfrider Foundation to argue such measures won't work. I believe it is significant to note that RBF also worked on the SCVURPPP team, but they are assisting the design team in applying those recommendations to the best advantage on the proposed toll road.

I'm sure that both PWA and RBF would agree with me that there is no silver bullet solution to hydromodification issues, (i.e., there is no way to guarantee zero impacts on stream channels from a new roadway). Nevertheless, I believe the design team has proposed an effective system that will both (a) minimize the effects from hydromodification and (b) provide a high degree of water quality protection. I see the intent of the system proposed through the stated design objectives for this project to use the most advanced knowledge of appropriate practice in order to incorporate the best design practices and

implement these designs in the most effective way possible. To me this indicates the TCA is committed to providing a roadway design that is as protective as possible of the watershed systems it crosses, and to constructing it in a manner that provides the least impact possible.

Sincerely,

Tetra Tech EC, Inc.

Derrick Coleman, Ph.D.
Senior Project Manager

Attachment A Hydromodification Materials Reviewed

REFERENCES

Coleman, D. J., C. MacRae, and E. Stein. Effect of Increases in Peak Flows and Imperviousness on the Morphology of Southern California Streams. Southern California Coastal Research Project (SCCWRP) Technical Report No. 450. April 2005. <http://www.sccwrp.org/pubs/techrpt.htm>

Santa Clara Valley Urban Runoff Pollution Prevention Program. Hydromodification Management Plan, Final Report, April 2005. <http://www.scvurppp-w2k.com/hmp_web_110404/HMP_report.htm>

ATTACHMENT A

Foothill Transportation Corridor – South

HYDROMODIFICATION MATERIALS REVIEWED

Document	Date	Description
PWA-1	11-JAN-2007	Final Report, Potential Toll Road Impacts on San Mateo Creek Watershed Processes, Mouth Morphology and Trestles Surfing Area; Prepared for The Surfrider Foundation; Prepared by Philip Williams & Associates, Ltd.
PWA-2	9-MAY-2007	Letter to the Surfrider Foundation from Philip Williams & Associates; Subject: Orange County Toll Road – Best Management Practices
RBF-1	8-JUN-2007	Memorandum to the Transportation Corridor Agencies from RBF Consulting; Subject: Updated Evaluation of Philip Williams and Associates Report Entitled Final Report, Potential Toll Road Impacts on San Mateo Creek Watershed Processes, Mouth Morphology and Trestles Surfing Area
SBC-1	26-JUL-2007	Final Runoff Management Plan, State Route 241; Submitted to the Foothill/Eastern Transportation Corridor Agency; Submitted by Saddleback Constructors
PWA-3	31-AUG-2007	Letter to the Surfrider Foundation from Philip Williams & Associates; Subject: Orange County Toll Road – Comments on Skelly Reports
SBC-2	6-NOV-2007	Memorandum to RBF Consulting from Saddleback Constructors; Foothill Transportation Corridor – South Runoff Management Plan Supplemental Documentation
PWA-4	17-JAN-2008	Letter to the California Coastal Commission from Philip Williams & Associates; Subject: Response to TCA Comments on PWA Watershed Analysis
PWA-5	22-JAN-2008	Letter to the California Coastal Commission from Philip Williams & Associates; Subject: Foothill Transportation Corridor-South Runoff Management Plan Supplemental Documentation Review and Comment *[Front page of letter is incorrectly dated 22-January-2007, subsequent pages have the correct date.]*
RBF-2	29-JAN-2008	Letter to the Transportation Agencies from RBF Consulting; Subject: Comments on January 17, 2008 Letter from PWA
RBF-3	29-JAN-2008	Letter to the Transportation Agencies from RBF Consulting; Subject: Comments on January 22nd, 2008 Letter from PWA
PWA-6	11-APR-2008	Letter to the California Coastal Commission from Philip Williams & Associates; Subject: Foothill Transportation Corridor–South Runoff Management Plan Supplemental Documentation Review and Comment – Sediment Size Clarification; Included copies of the following articles: Everts, C. H., Eldon C. R., and Moore, J. (2002). Performance of Cobble Berms in Southern California. Shore and Beach, v. 70, no. 4, October, pp. 5-14. Inman, D. L. and Jenkins, S. A. (2001). Abstract: Processes on Narrow Beaches with Sandy Foreshores and Cobble Berms. Presented at the Joint Conference of the California Shore and Beach Preservation Association (CSBPA) and the California Coastal Coalition (CalCoast) entitled "Restoring the Beach - Science, Policy and Funding. Horn, D. P., Baldock, T. E., and Li, L. (2007). The Influence of Groundwater on Profile Evolution of Fine and Coarse Sand Beaches. Paper presented to the ASCE Coastal Sediments '07 Conference, Coastal Engineering and Science in Cascading Spatial and Temporal Scales, May, pp. 506-519. She, K., Trim, L., Horn, D., and Canning, P. (2007). Effects of Permeability on the Performance of Mixed Sand-Gravel Beaches. Paper presented to the ASCE Coastal Sediments '07 Conference, Coastal Engineering and Science in Cascading Spatial and Temporal Scales, May, pp. 520-530. Komar, P. (2007). The Design of Stable and Aesthetic Beach Fills: Learning from Nature. Paper presented to the ASCE Coastal Sediments '07 Conference, Coastal Engineering and Science in Cascading Spatial and Temporal Scales, May, pp. 420-433.